Vol. IV. OCTOBER, 1887. No. 6.

American Meteorological Journal.

A Monthly Review of Meteorology, Medical Climatology, and Geography.

TABLE OF CONTENTS.

ANN ARBOR, MICH., U. S. A.:
METEOROLOGICAL JOURNAL COMPANY.
19, 21 and 23 Huron Street.

F. A. BROCKHAUS, Leipsic, Berlin, and Vienna, Agent for German and Austrian States.

Single Copies, 25 cents. Per Annum, $2.00. In European Countries, $2.25.

Entered at the Ann Arbor Postoffice as Second Class Matter.

THE AMERICAN
METEOROLOGICAL JOURNAL.

VOL. IV. ANN ARBOR, OCTOBER, 1887. NO. 6.

CURRENT NOTES.

RESIGNATIONS FROM THE SIGNAL SERVICE.—We regret to learn of two resignations from the service. The continued ill health of Professor Frank Waldo has obliged him to resign his position as junior professor. Mr. Waldo's principal work has been in the line of the so-called theoretical meteorology and the theory and practical use of standard and self-registering meteorological instruments for which he prepared himself by an extended personal acquaintance with the methods of the chief meteorologists of Europe. We feel sure that he will continue his meteorological work as far as his health will allow, even though he has given up his professional duties under the government. His address is now E. Forest Avenue, Cincinnati, Ohio.

Professor Geo. E. Curtis resigns to accept a professorship of astronomy and mathematics at Washburn College, Topeka, Kansas. We hope that he will find more leisure in his new position to write for us.

A GEORGIA CYCLONE PIT.—A Savannah, Ga., paper says: Perhaps the largest, best arranged, best furnished, and most costly cyclone pit in the country is owned by Ed Brown, of Eatonton. It is situated near the back door of his residence and is large enough to accommodate his whole family. The walls are of brick, laid in cement, the floor is carpeted, has a fireplace and chimney, and the room is handsomely furnished. The family could spend the night there with as much comfort as in the dwelling.

In preparing it Mr. Brown had an eye to its permanency and spared no expense in making it pleasant and comfortable. To guard against the contingency of the house blowing over on it and imprisoning the inmates a large sewer pipe leads off from the pit in an opposite direction a distance of one hundred yards, through which the family could escape. This unique and underground dwelling is thoroughly protected against water rising from below or running in from above. The cost was over $500.

THE OBSERVATORY OF LA PLATA.—This observatory is in the city of La Plata (Lat. 34° 54′ 30″ S., Long. 57° 55′ W. of Greenwich), somewhat southeast of the city of Buenos Ayres (Lat. 34° 36′ 30″ S., Long. 58° 22′ 15″ W.), and close to the town of Ensenada, which can be found on the maps. The city of La Plata seems to be a new one, and to contain 15,000 or 20,000 inhabitants. The first annual report of the observatory is for the year 1887, and is made in the form and style of the well-known *Annuaire des longitudes.* The volume contains, besides the astronomical tables to be expected, several tables of positions and elevations of value to geographers, tables of local weights and measures, which we have never seen elsewhere, and some meteorological tables. The observatory is establishing a telegraphic meteorological system and promises very good work. The director of the observatory is Don Francisco Beuf, who has a corps of six assistants. The annual gives one much confidence in the competency and enterprise of the director, who is, by the way, the author of a work on geodesy and topography.

A CHANGE IN MONTANA'S CLIMATE.—When the late General Hazen passed through Northern Dakota before the Northern Pacific Railroad was built, about eighteen or twenty years ago, he described the Territory as a barren, worthless country without a possibility of raising crops, owing to a lack of rainfall. One who traveled the same route to-day would see the country dotted thickly with homesteads and crops of all kinds of small grain growing luxuriously with promise of a splendid harvest. We think General Hazen was honest in his estimate of the

country as it existed at that time, but settlement and civilization have so changed the climate that Northern Dakota takes rank now as one of the best sections for small grain in the United States. There is no doubt but this process of change is going on constantly, and no doubt but some day in the near future the Yellowstone Valley will be one continuous grain field. The present season is a sample of what we may look for. There have been almost continuous rains during the growing season, and those who have crops in report them as fine as are to be found in any State in the Union. Vegetable gardens that escaped the hail are simply immense, and as fine samples are brought into town as can be found anywhere.—*Glendive Independent.*

THE BELGIAN PRIZE ON GEOGRAPHICAL INSTRUCTION.—A recent number of *Le Mouvement geographique* gives the result of this contest, the substance of which is as follows: By the time appointed for the submission of the manuscripts, December 1st, 1885, there were sixty handed in, but the king was unable to bring together an international jury until recently. Their report is signed J. Liagre, president; Georges Lebron, N. de Tchitchagoff, Juan Valera, J. Van Beneclere; H. Wauwermans, reporter.

The first work consisted in eliminating thirty-seven of the manuscripts offered. From the remaining twenty-three the process of removal continued until six were left, which the jury decided should receive honorable mention. These are: No. 40, by M. Henri Matza, of Hesse-Nassau; No. 49, by Dr. Oscar Schneider, of Dresden, Saxony; No. 32, by Mr. Richard Owen, Professor, at New Harmony, Indiana, U. S. A.; No. 51, by a Belgian, name not given by the author, but bearing the motto, "Precision and Repetition;" No. 55, by Jean Baptiste Gochet, of Belgium; finally, No. 7, by M. Anton Stauber, professor in the Royal Gymnasium at Augsburg, Bavaria. To the latter gentleman the prize of 25,000 francs was awarded by the jury.

From the above it will be seen that the distinguished Indiana scientist was among six out of sixty competitors who receive honorable mention in this world-wide contest for the above valu-

able prize for geographical knowledge. This is indeed a high honor. Professor Owen has reflected great credit on his State and country, not only in this achievement of his declining years, but frequently heretofore during his long and useful career devoted to the interests of learning and science.

QUARANTINE INJUSTICE.—During the past summer the American ports on the Gulf of Mexico have quarantined strictly against the entire eastern coast of Central America. During this time yellow fever has been epidemic in its usual haunts—Vera Cruz, Havana, and Colon—and also in Key West, but for the entire stretch of coast from Cape Catoche to Colon, there has been, not only no epidemic of yellow fever or other contagious diseases, but no certain sporadic cases. Belize has had a few cases of pernicious but non-contagious malarial fever, and Livingston sent one such case to the quarantine station at the mouth of the Mississippi river. Throughout the remainder of the coast in question there have been no suspicious cases, and the health has been generally better than at New Orleans. Indeed, the writer of this note knows personally of a gentleman who took a fever on the lower Mississippi river and came to Puerto Cortez, in Honduras, for his health, and there recovered.

The quarantine does so much damage to commerce and so much hardship to individuals that it should not be established against any port without good cause. Yet here is a coast extending through fifteen degrees of latitude where the health was satisfactory, the commerce and travel of which has been hampered through its natural outlet for several months. New Orleans is, of course, justified in jealously guarding its population from dangerous epidemics, but is it justified in arbitrarily hampering communication from hundreds of miles of healthy coast? The criticism which can be fairly made against last summer's quarantine is that it was too general. To protect against three or four dangerous points, a quarantine was made against scores of others. This is an injustice to business men throughout the territories tributary to the ports of the coast, and works serious damage to our commerce.

METEOROLOGY AT THE MEDICAL CONGRESS.—The International Medical Congress recently held at Washington was the representative medical event of the year, and it is interesting to note that considerable attention was paid in it to meteorology in one aspect or another. The following abstracts are from the *Sanitary News*:

"Dr. Albert L. Gihon, of the U. S. Navy, placed climatology and demography as sciences contributary to preventive medicine. Vital statistics of the future must contain sickness records also.

Dr. Henry B. Baker, of Lansing, Mich., secretary of the state board of health, read a paper illustrated with diagrams showing the correspondences between atmospheric temperature and the prevalence of influenza, tonsilitis, croup, bronchitis and pneumonia. These diseases, he believes, are always caused by cold, dry air, which, falling on susceptible surfaces, tends to produce an abnormal dryness which may be followed by irritation and suppuration. He showed, by statistics which he had published, that the rise and fall of such contagious diseases as scarlet fever, diphtheria, and small-pox are controlled by the same law, the inhalation of cold air causing irritated surfaces which provided a nidus for the contagia to locate.

Dr. P. H. Bryce, of Toronto, spoke of artificial atmospheres in houses, and stated that the remedies for the evils mentioned are sunlight in abundance, greater care in the construction of dwellings, foundations, and plumbing appliances, improved municipal sanitation, and the attainment of equable heating and thorough ventilation. It must be recognized, he said, that the fatal effects of the imperfect conditions of human life under which Indians, negroes, and many of the people of limited means exist, demand the earnest consideration of all workers in the field of climatology and demography; and, since the occupations, urban residence, and limited means make it impossible for an increasing porportion of our population to enjoy the health-giving influences of rural residence and the stimulating effects of life by the ever restless ocean, or upon the mountain side, we shall best conceive the duties assigned to us, of making it possible for every willing citizen so to live under his own roof as to maintain a vigor unimpaired for the discharge of work lying nearest him, and to transmit to the race that is to be a legacy of physical health."

In a paper on "The Effects of the Overflow of the Mississippi River," Dr. R. H. Day, of Baton Rouge, La., showed (1) that overflows, as a general rule, are injurious to the public health; (2) that they are more or less injurious according as the inun-

dations are late or early in the season, and whether of long or short duration; (3) that their evil effects upon health are lessened or entirely antagonized by good, natural or artificial drainage, and by copious showers of rain occurring during the period of subsidence of the waters; (4) that the rice culture is inimical to health only by reason of the improper and unsanitary manner of its cultivation; (5) that, as a rule, it is perhaps true that the colored race is less susceptible to the injurious effects of overflows, and of marshy and malarial soils, than the white race.

CLIMATE OF COLOMBIA.—Consul Smith, of Carthagena, says, in a recent report to the Department of State:

"There is a very erroneous idea prevailing in the United States as to the sickly climate of Colombia. In this country all conditions of climate can be found. On the coast lands it is warm, but, with exception of the Isthmus, it is not unhealthy. On the coast there are two seasons, the dry and rainy; the dry begins in December and lasts until June. During this season the tropical heat on the coast lands is tempered by the refreshing breezes of the 'trades.' The prevailing diseases are of a malarial character; those of an epidemic nature rarely prevail. During the last eight years I have noted but one epidemic, that of small pox. The number of deaths was quite small, due to the forced vaccination of all of the inhabitants. The epidemic, by these means, was promptly checked. About 300 miles distant from the coast the land is about 3,000 to 4,000 feet above the level of the sea, and the climate is a most delightful one to live in. The further you go in the interior the higher the land becomes, until you strike the plains of Bogota, where you reach an elevation of 10,000 feet above the level of the sea, and overcoats are in demand. As regards living in this consular district, I am prepared to state that if one but observes the laws of health the same here as he would in his own country, he will live just as long, and perhaps longer, than if he had remained in his own country."

The error as to the health of Colombia is a very serious one for that republic itself and for our commerce with it, and the same error prevails as to other parts of tropical America. As a matter of fact, the climate of tropical America is, with the exception of a few points, such as the Isthmus of Panama, not only healthful but remarkably good,—in fact often like that which Eden must have had. Para, at the mouth of the Amazon, is

decidedly healthful. British Guiana, notwithstanding its swampy coast, is the same, and along the Blewfields river in Nicaragua, a part of the dreaded Mosquito coast, there is now a colony of American planters who do not complain of the climate. The old notions of the sanitary conditions of this entire coast are undoubtedly as erroneous as were those of the Great American Desert. If we are really to play an important part in the commerce of this region, it is time we revised our ideas as to its healthfulness.

TREES AND WATER-COURSES.—Our consul at Sydney wrote some time ago:

"The forests of New South Wales and of other portions of Australia are destroyed in various ways, but principally by ring-barking. This process consists in simply cutting a ring about six to ten inches wide around the tree with an ax or tomahawk. The time chosen for this process is in the autumn, when the sap has matured and is ready for repose. The destruction of forests in this way has become so great as to seriously attract the attention of the government. It appears to have begun about thirty years ago in the water-shed of the Hunter river, but it did not become very general until the inauguration of what is called free selection, by which certain tracts of land were opened up to persons who had erected homesteads at low prices. The free selectors usually chose heavily timbered districts, and in a short time the wholesale destruction of forests began. Ring-barking was thought to be the best means for clearing land, not only for small farms but for grazing purposes. According to an interesting and valuable paper on this subject, prepared by Mr. W. E. Abbott, for the Royal Geographical Society of New South Wales, the objections urged against this method were that the creeks and rivers would dry up owing to the increased evaporation, and that the rainfall would be reduced by the removal of the large condensing surface offered by the winds when heavily laden with moisture. Mr. Abbott has given some practical illustrations resulting from his experience. In 1869 and 1870 he ring-barked the greater part of the water-shed of two creeks,

and the whole of the water-shed of a third, being about two miles, and draining a well-defined valley shut in by high ridges of basalt. He noticed, as soon as the timber was dead, that one of the creeks assumed the character of a permanent stream, and that the others were very greatly improved. In 1878 all three became permanent streams, and have continued such ever since. Previous to the ring-barking they were dried up during a portion of the year. Until these experiments were made it was regarded as the height of absurdity for any one to destroy timber for the purpose of producing water on his land. Now it is done every day. Mr. Abbott does not think that the destruction of forests will reduce the rainfall, but he argues that when there is a large and regular rainfall there is sure to be a heavy forest growth, and that the forest is the result of the rainfall, and not the rainfall of the forest. Mr. Abbott attributed the increased flow of water on his land, first, to the fact that the roots of the trees decaying acted as a sort of subsoil drainage, leading the water down into the subsoil and afterward allowing it to drain off slowly into the water-courses, proving it to be of a temporary benefit only; second, that a large proportion of the rainfall which was formerly taken up by the roots of the growing trees and evaporated from the leaves was enabled to find its way to the creeks and rivers. Mr. Abbott says: The fact that the eucalyptus, so common throughout Australia, is perhaps the most vigorous growing tree known, and that it is used successfully in other parts of the world to dry up swampy land, would seem to support this explanation."

RELATION OF ARSON TO SEASONS.—The *Chronicle*, of New York, whose studies of fire and suicide statistics are very valuable, says that incendiary fires for 1883 to 1886 in the United States were distributed through the months as follows: January 120, February 104, March 129, April 136, May 143, June 119, July 130, August 152, September 190, October 197, November 214, December 155.

"The distribution of incendiarism by months and seasons," the editor goes on to say, "is not without interest. The crime

of suicide is known to be comparatively frequent in certain months and infrequent in others. The same peculiarity marks the distribution of other crimes. The monthly curves of incendiary fires during the four years ending with 1886 show that whatever the number of criminal fires in January there are likely to be fewer in February; March is likely to have more than February, April more than March, and May more than April. In June the incendiary takes a rest. In July he is a little busier than in June, with a tendency to be very active in August and September. He is generally more riotous in October than in September, while in November he manifests an equal inclination to increase or diminish his business. In every year of the four there have been fewer criminal fires in December than in November. The greatest number of these fires is attributed to November, but this result appears to have been mainly due to an intensity of incendiarism in November, 1886, which may have been an outgrowth of the widespread labor troubles prevailing last autumn, or possibly to other causes. This monthly distribution of criminal fires is decidedly queer. For four years the number in January, May, June and July has been singularly uniform. The months in which the fluctuations of the incendiary wave are most pronounced are September, October and November. Indeed, there seems to be an extraordinary regularity in the number of criminal fires in the first six months of the year; we find the chief irregularities and widest fluctuations in the last half of the year. And we find another thing, viz., that in this period criminal fires, taking the whole country, are excessive compared with the earlier months."

No suggestion is made as to the cause of the two maxima of incendiary fires in spring and autumn farther than that it is moral and due to the agricultural classes. The writer of the article overlooked, apparently, a coincidence that suggests a more probable explanation. The forest fires are also most common and most destructive in these two seasons. The autumn fires are usually the worst, but those of spring are often serious. In the case of these fires there is little reason to look for moral causes. The maxima of their occurrence are

undoubtedly due to the favorable climatic condition at those seasons, and this is due to the lack of rainfall and clear skies. There is a period between the disappearance of the snow and the spring rains when everything is dried out and ready for a fire, and the same condition is even more marked in autumn.

SNOW AVALANCHES IN MONTANA.—The little spot of land between the Rockies on the west, Minnesota on the east, and north of the 47th parallel, has a greater range of temperature than any other portion of the known globe, wrote a Fort Keogh, Montana, correspondent of *The New York Sun.* Last summer the thermometer registered 123 and 124 degrees Fahrenheit above zero in the shade, and only three days ago the spirit registers showed 60 degrees below zero. This year the snowfall is unprecedented. All around the Butte camp are piles of snow such as have not been equaled for years past.

Three days ago two prospectors in the Cooke City mining district were up on the side of a steep mountain working on a tunnel. Martin and West were busy at work blasting and delving, without thinking of danger, when from the top of the lofty summit many tons of snow shot down the steep incline.

"Look out!" screamed West, and both sprang behind a two-foot pine tree. The hugh mass came tearing along and hurled the tree and the two miners in the awful abyss thousands of feet below, and covered them beyond all rescue. The bodies of the poor fellows are there yet, and there is no prospect of securing them until next summer.

In Emigrant gulch, a few miles west of here, the snowfall is beyond all conception. A series of avalanches has been sweeping down Emigrant peak, tearing cabins from their foundations and burying them out of sight, although, fortunately, no one has been hurt. An old miner of that section told me a remarkable story of an avalanche which occurred in the gulch two or three years ago. Emigrant gulch is a great place for silver-tip bears. In winter they become so hungry that they hunt all over Emigrant mountain for berries and roots, and even descend into the bed of the gulch and attack anything living, to satisfy their hun-

ger. He had spent the winter about five miles up the gulch on the north side of the gorge, Emigrant peak rising eleven thousand feet into the air directly opposite him. One sunny day, while sitting alone at his cabin door, he saw far up the mountain side a number of bears winding along through the snow. He counted eight of the monsters as they came in sight one after the other.

All at once the mass of snow capping the bald summit became loose and started on a rapid journey toward the bed of the gulch. In an instant it had reached the bears, and, picking them up, it tore trees up by the roots and seized huge bowlders of stone, which were hurled with a crash far into the depths below. The noise was something deafening until the avalanche had stopped in its course. Looking upward, he saw a broad swath or path which the avalanche had cut clean from peak to base, as if some farmer had with a giant scythe cleaned the earth of trees, rocks, and herbage.

SNOW IN COLORADO.—"How often is the snow renewed on the tops of the mountains in Colorado," asked a reporter of a pioneer Coloradoan, Mr. William N. Byers, who has observed the face of nature in the Rockies for many years.

"Well," said he, "that is a gigantic question which Hayden asked himself years ago, but utterly failed to answer. Some persons think the snow is renewed on the mountains here every two years, but I doubt it gravely, and after all it is a matter of the merest conjecture. We can only use our powers of observation and draw our inferences from the most practical reasons at hand. You have heard, of course, that the main difference existing between our mountains and those of the old world lies in the fact that there glaciers abound, whereas we are free from those terrible anathemas of ice and snow.

"But there are plentiful traces of glacial action at the head of the Arkansas river, and about Lake creek, in the neighborhood of Twin lakes, and on both sides of the Arkansas valley. These traces are a remarkable feature of the rocks. They are called moraines. The rocks are scored in places along the foot

of the mountains, and the pushing out of moraines into the Arkansas is observed.

"Another remarkable instance is seen in the region of Grand lake, in Middle Park, in the scoring of the rocks in the terminal and lateral moraines. Nearly all these lakes are the result of glacial action. In every ravine in the glacial period there were rivers of ice. As the ravines unite, the ice rivers accumulate in the passage down the ravines, and are multiplied in junction with other ravines until they become plows of ice. These plows push both to the right and to the left, but the greater portion is pushed on in front, and is called terminal moraine. The masses pushed out at the sides are known as lateral moraines.

"This is like a plow with a double share, turning a furrow both right and left. The effect on the unbroken rock is to scour and polish it, and to score it into grooves, sweeping everything movable before it, depositing all this moving matter at its sides and directly in front. When the glacial period ended and the temperature of this part of the earth changed, it left these rivers of ice projecting down into the plains at the mouth of the gorge, penetrating the surface of the earth to more or less depth, and running through until they gradually melted away. Thus were formed most of our mountain lakes, such as Twin, Grand, and Black. I once counted from the summit of Long's Peak thirty-five lakes, some of which are covered with ice all the year through.

"The snow probably remains for generations or centuries in many of the snow-fields which yet exist in the Rocky Mountains. I think it is possible that the snow melts underneath, and it is replaced. It is safe to say there are no living glaciers now in this portion of the Rocky Mountains. There is, however, a slow, hardly perceptible motion of the snow-fields down hill.

"Frost has been found in many of the mines in the high mountains, above timber-line, at great depth. In the North Star mine, near Hoosier Pass, frost was found at a depth of 148 feet. The great extent of plateau country causes the high temperature of the mountain ranges, and is the cause of the snow

melting off, in direct contrast to the mountains of Switzerland or those of the sea-coast. The mountains of the sea-coast have a low snow-line, and it is this which causes glaciers. Along the Alaskan coast the glaciers are pushing out into the sea.

"As for the mountains here, they are much like those of the Himalaya range in Asia, having the same high snow-line. This is another argument in favor of Colorado. The high snow-line insures a dry, bracing, tonic climate.

"The snow-fields worthy of mention, which last all the year around, are situated between Long's Peak and Middle Park. These remain during the summer. I have often observed the glacial action on the fences in Middle Park. It moves them every winter. This motion is not great. In fact, it is so slow as to be almost imperceptible. Snow-slides are very common in Colorado, and most common in the San Juan, near the main range. They occur every year, and frequently, when snow falls to any extent.

"Many lives are lost in snow-slides, because people ,who become indifferent to danger through long association with it, will insist on building houses in the wrong location. When snow begins in the mountains it often falls twenty, thirty, or forty feet, and so covers up the old snow. The ground is frozen. The frost never comes out of the ground. When we dig there, we always find the earth frozen. It may be that the snow gradually melts away, but, as I said before, nobody knows anything about it positively. It is a mere matter of conjecture. There are places in the mountains where I do not think the snow ever melts. I do not believe there is any spot where timber grows that snow does not melt. If the snow had not melted the timber never could have grown. Above timber growth perpetual shade cannot exist except under a ledge of rock. The sun gets around everywhere in the summer time.

"It is estimated," said State Engineer Nettleton to the reporter later, "that sixty inches of water fall annually on the eastern slope of the Rocky Mountains in the form of snow and rain; 80 per cent. of this falls during the winter and spring months. That which falls late in the autumn and early in the

winter is most available for irrigation, as it becomes solid, almost like ice, and melts slowly under the summer's sun, affording a steady flow through the irrigating season. Snows falling in late spring melt rapidly, and the waters run down the rivers unused. Although about fifty mountain peaks in Colorado reach an elevation of over 14,000 feet, yet the snow nearly all disappears every season, small quantities only remaining in patches here and there. On this account there are at present no glaciers in the Rocky Mountains. The cold mountains condense the moisture in the country adjacent, thereby robbing the plains of their quota of moisture.

"Hence the necessity for irrigation. It is quite easy to foretell the probable amount of water for irrigation purposes for the coming season by watching the amount of snowfall in the mountains.

"Farmers living from twenty to thirty miles from the mountains, or where they can watch the snowfall on the main range of the mountains, have learned how to guage their crops by the time the snow falls and the quantity. If the snow falls early they expect water for late crops. If the snow falls principally in the spring months, they fear short water in summer and fall, and plant or sow accordingly.

"There can be no doubt about the influence that cutting or burning the timber on the mountains has on the flow of our streams. They will on this account become more intermittent in their flow, which is a drawback to the irrigation interests of the state. The preservation of the mountain forests should be encouraged," concluded Mr. Nettleton emphatically.

Then an old miner came along and described a snow-slide in the San Juan. He said the awful grandeur of such a scene was indescribable. The snow usually came roaring down at night, when the voice of the wind was sobbing and moaning through the pine trees, as if it were some human thing sent forth to roam about the earth through all the ages. There was usually a high wind, a great crash, and then for a time all was chaos, and he who came out alive thanked his lucky stars and prepared to move his cabin to some warmer clime. He said there were

a great many lives lost in Colorado by means of snow-slides. Last year two hundred people were sacrificed to the snow fiend.

He had often noticed long, bare places on the mountains, where the snow-slides had torn away the trees and hurled them with tremendous force against the rocks of the deep canyon below. "It is hard to say," he continued, "as to where it is safe to live in the San Juan. Occasionally there are snow-slides about Mosquito Pass and over and about Aspen. March is the most dangerous month in the year in those mountainous regions. It is then that the snow king holds high carnival, playing with, it always seems, human lives for very amusement."—*Denver Tribune-Republican.*

The Forestry Congress.—The congress was held in September, in Springfield, Illinois. Many matters of interest were discussed in it. We take our extracts from the Chicago *Times*' reports.

"Prof. J. L. Budd, of Iowa, read a paper upon 'Possible Modification of Prairie Climate.' 'Forty years ago,' he said, 'our westerly winds came to us across, and gathered their moisture from, ponds, swamps, etc., but now the surface of the great west had been turned by the plow, and the large amount of drainage caused the winds to come across a dry and parched country from which no moisture could be gathered. Our winds from the south were hotter and dryer than twenty years ago from a similar cause. The tendency of drought would be more manifested as the still unoccupied lands of the west were taken up and cultivated. In Russia, while they were not united upon the theory that forest planting created an increase in rainfall, they did agree that it caused a more equal distribution of the moisture.'"

"Dr. Daniel Berry, of Carmi, Ill., read an excellent paper upon 'The Influence of Western Treeless Plains on the Atmospheric Conditions Eastward of Them,' which showed great research and study of air currents and causes which influence their course. The fact that once verdure-clad western plains were yearly reduced to plowed grounds, and the further fact that the forests of the west and southwest and of the mountains were almost obliterated, explained to his mind the increased dryness from year to year of the air currents that swept over the Mississippi valley. The currents are now dry and arid, instead of moisture-laden as formerly. Again, tilling throughout the west rapidly carries off the rainfall to the rivers, whence it flows in freshets to the sea, without, as formerly, remaining in the ground to become a source of vapor

and clouds. The planting of forests at regular intervals throughout the west is the only remedy."

"Mr. S. C. Robb, state forest commissioner of Kansas, read a paper upon 'The Status of Artificial Forest Planting on the Plains.' What was called the great American desert now had many flourishing groves of trees from 6 to 8 years old. The planting of trees was mostly attributed to the timber-culture law passed by Congress, and the timber planted in this way aggregated many thousands of acres."

"A brief but instructive paper on 'The Climatology, Geography, and Topography of the Great Continental Plains of North America' was read by Col. D. A. Robertson, of St. Paul, Minn. It demonstrated the author's intimate acquaintance with all the subjects on which he treated, and furnished manifold proofs of the influence of forests on the climate of North America."

Joaquin Miller, as representative for the state of California, read an enthusiastic paper, from which we quote only some interesting remarks of Captain Eads concerning the composition of the Mississippi mud:

"I believe it is pretty generally conceded that our continent is being washed into the sea by way of the Mississippi and its thousands of miles of tributaries, on the one hand, and at the same time swept naked of its native forests by annual fires, on the other. I take it that it is this deplorable condition of things that has called into existence the American congress of forestry. I spent some time with the late Captain Eads at the mouth of the Father of Waters inspecting his jetties two years ago.

'We have begun at the wrong end,' said the great man more than once to me.

One morning he threw a bucket over the side of the boat and drew up several gallons of dark mud and water.

'There,' cried the great engineer, 'is a mixture of one-tenth Missouri, one-tenth Illinois, one-tenth Iowa, one fraction Kentucky, and so on, through about fifteen states, with an addition of about five-tenths of pure water.'

'And what would you do, Captain Eads, to stop this washing away of states?'

'As I told you,' remarked the energetic old man, as he dumped the ugly mixture back into the Gulf of Mexico, 'we have begun at the wrong end. But the country is not educated up to the point of beginning. It wants the other end for wheat and corn. It only wants the mouth of the river kept open so as to be able to sell its corn for the present generation, and let the next generation look out for itself. The other end of the river has drowned out this end; state after state is going to be drowned out, until some day the coral insect may again

build his pretty castles where the people of Iowa are now digging wells for water. The United States is tearing out her very heart with her gang-plows, and dumping it into the sea, sir.'

I beg to put this statement before the country with something of the emphasis with which this great and good man uttered it there in the mouth of the great river. More than once he brought up the subject, and always with an emphasis that would write every syllable in italics.

Captain Eads was very fond of quoting poetry. Once he was saying to himself, 'Leaves, leaves, nothing but leaves,' when he suddenly turned to me and said: 'Do you know that in leaves you can read the history of creation? My son, leaves are not only creation but salvation.' I am now writing down his words, literally from notes taken at the time.

Captain Eads explained to me that he meant if leaves and grass were left lying on the ground at the proper time of the year, as nature, the hand of God, placed them, there would never be any damage from high water any time; the leaves would be the salvation of the republic, and that there would never be any need of Eads's jetties. He explained that he meant, when he said that leaves were creation, that there is no nourishment so dear to the hungry earth as a handful of leaves. He insisted that more beauty could be grown out of a single basket of leaves than in a whole load of manure."

It seems that California is taking active steps to have a national forestry law. She has drafted such a plan, which is to be presented to congress. It appears that this state suffers intolerably from forest fires.

"The constitution of the congress was so amended as to add the month of October to the two preceding months in which the annual session may be held. The life membership was raised from $10 to $100, and the secretary was ordered to drop from the list of membership the names of all those in arrears for dues. The president was authorized to appoint a committee to present to Congress the memorial and bill for the preservation of trees adopted at the present session, and it was ordered that the New England committee be retained as now constituted.

Resolutions were adopted favoring the unification of the agricultural and horticultural societies of the country; asking the legislatures to stimulate forestry by proper legislation and the appointment of commissioners, and that Arbor Day be observed by all the public schools. A resolution was introduced asking the legislatures to encourage tree-planting by exemptions for a period of fifteen years, but as the president stated that such was unconstitutional and could not be enacted into a law in Illinois, it was withdrawn."

The congress is not as prosperous as it should be, for it seems

that the committee on finance reported that of the 215 members of the congress only 12 had paid their dues to date and were in good standing. The following officers were elected for the ensuing year:

President—Hon. C. R. Pringle, of Sandersville, Ga.

Vice Presidents—Hons. H. C. Jolly, of Quebec; D. B. Gillham, of Alton, Ill.; Joseph S. Fay, of Boston; G. H. Parsons, of Colorado; Abbot Kinney, of California.

Treasurer—Martin Conrad, of Chicago.

Corresponding Secretary—B. E. Fernow, of Washington.

Recording Secretary—Charles E. Bell, of Boonville, Mo.

The memorial above referred to is as follows:

To the Senate and House of Representatives in Congress Assembled:

Your memorialists, the American Forestry Congress and citizens of the United States, respectfully represent:

WHEREAS, The present laws in regard to the public lands, as far as they relate to the disposal of timber-lands or of the timber from the same, are entirely inadequate to the requirements of the present state of our civilization; are unreasonable, pernicious, and prejudicial to the best interests of the country and have a tendency to induce fraud, theft, and perjury;

WHEREAS, Especially in the Rocky mountain and Pacific slope region the mining interests, in regard to material supplies and the agricultural interests, in regard to a favorable distribution of water supply, are threatened with danger or have already been endangered by the thoughtless and unnecessary denudation of the mountain slopes and hillsides;

WHEREAS, By ax, by the teeth of cattle, and by fire many millions of dollars' worth of public property have been destroyed without benefit to anyone, owing to the neglect on the part of the government to protect the property of the people;

WHEREAS, Favorable agricultural climatic conditions of a country are largely dependent upon a proper amount of well-distributed forest areas, and especially upon the preservation of the forest cover on the mountains;

WHEREAS, Such preservation cannot be had under the existing laws, nor can be expected at the hands of private individuals;

WHEREAS, By the disposal of the timbered areas now in the hands of the United States and by the devastation under present conditions going on unheeded, the power to insure proper forest regulation passes from the people;

Therefore, The undersigned memorialists, imbued solely by a desire to further the best interests of the country at large, most respectfully and

urgently pray that you will, without delay, give consideration to and enact as a law the subjoined bill, which provides for the withdrawal from entry or sale, classification, and proper disposal or administration of public forest lands.

The following are the provisions of a bill adopted for the protection and administration of the forests on the public domain:

Section 1 defines public forest lands.

Section 2 provides for the withdrawal of all public forest lands from entry or sale under the existing laws preliminary to the classification.

Section 3 requires persons making entries for land to furnish evidence that the land applied for does not fall under the class of forest lands.

Section 4 creates a commissioner of forests in the department of the interior, appointed by the president, holding office during good behavior, and receiving a salary of $4,000, and to have the care, management, and control of the public forest lands.

Section 5 provides four assistant commissioners, specially qualified, to act as counsel to the commissioner of forestry, and having each special charge of one division of the public forest lands, receiving a salary of $3,000 each.

Section 6 defines three general classes of public forest lands: (a) Lands distant from headwaters of the streams covered by timber of commercial value, more valuable for forest purposes than for cultivation; (b) lands partially or wholly covered by timber, but suitable for homesteads, and more valuable for agricultural purposes than for timber; (c) mountainous and other woodlands, which for climatic, economic or public reasons should be held permanently as forest reserves.

Section 7 requires the commissioner to classify and designate, with the approval of the secretary of the interior, the permanent forest reserves (class three). Such reserves to be proclaimed by the president of the United States.

Section 8 provides for the appraisement of timber on classes one and two.

Section 9 authorizes the president to direct the sale of timber on lands of class one, not exceeding 25,000 acres at one sale in the aggregate.

Section 10 regulates the manner of such sale to the highest bidder.

Section 11 provides that lands of the second class shall be restored to homestead entry.

Section 12 provides for co-operation of other federal officers in the selection and classification of public forest lands.

Section 13 describes further duties of commissioner of forests; requires him to divide and arrange reserves into districts and divisions and to organize a service of inspectors and rangers, make rules and reg-

ulations in regard to the use and occupancy of forest lands, sell timber to satify local demands, and provide a practical system of forestry for the forest reserve.

Section 14 allows co-operation with state forestry boards.

Section 15 provides fines and penalties for unauthorized cutting of timber on forest reserves.

Section 16 provides fines and penalties for taking off of trees and other trespass on forest lands, allowing, however, the exercise of rights previously existing to take timber under regulations of the commissioner of forests.

Section 17 provides fines and penalties for occupying public lands with saw-mills, manufacturing, or otherwise.

Section 18 empowers the president to use military force for the purpose of protecting forest lands.

Section 19 provides fines and penalties for aiding in transporting illegally cut timber.

Section 20 forbids the commissioner of forests and other officers under him to be engaged in a lumbering business.

Section 21, repeal of former laws.

Section 22, enacting clause.

Section 23, appropriation of $500,000 provided.

SOME RESULTS DERIVED FROM THE HOURLY OBSERVATIONS OF ATMOSPHERIC PRESSURE AT THE BLUE HILL OBSERVATORY DURING 1886.

As mentioned in the JOURNAL for June, very few hourly barometer records have been published or discussed in the United States.

The following results are based upon a series of hourly readings taken from a Draper mercurial barograph whose instrumental error was ascertained several times daily by comparison with a standard Hicks, and the resulting corrections interpolated for each hour. The barograph gives the actual pressure, the correction for temperature being automatically made. The series of hourly readings is complete for the year, the values for four scattered missing hours having been interpolated.

The Blue Hill Meteorological Observatory is situated in latitude 42° 12′ 44″ N., longitude 71° 6′ 53″ W., and 640 feet above the sea, from which it is distant about ten miles.

I. *Comparisons of the monthly and annual means of hourly*

observations with the means of (a) *tri-daily observations at 7 a. m., 3 and 11 p. m., which was the method formerly used by the Signal Service to determine the mean pressure;* (b) *tri-daily observations at 7 a. m., 3 and 10 p. m., which is the method now used by the Signal Service, and* (c) *observations made at a single hour.*

(a) The annual mean of the tri-daily observations differed by —0.002 inch from the annual mean of the hourly observations. The largest deviation was —0.010 inch for April, while in March, May, August and December, it was 0.000 inch. The average deviation for any month was ±0.003 inch.

(b) The annual mean from these hours differed only by —0.001 inch from the true hourly mean. The greatest deviation for any month was +0.004 inch in September and October, and the least 0.000 inch in February. The average deviation for any month was ±0.002 inch. This combination of hours, therefore, gives a closer approximation to the true mean than does the combination (a) formerly used by the Signal Service.

(c) If but one observation a day is taken, the best hour to choose, to approximate most closely to the true mean, is midnight. The annual mean of observations at this hour corresponded exactly to the mean of the twenty-four hours. Its extreme variation from the mean of any month is +0.014 inch and the average deviation ±0.0054 inch. The next best hour from which to obtain the mean is 8 P. M. The annual mean of this hour also corresponded exactly to the annual hourly mean. The extreme variation between any monthly mean of this hour and the monthly mean of the twenty-four hours was +0.014 inch, and the average deviation ±0.0056 inch.

DIURNAL VARIATION OF THE PRESSURE.

(a) Times of maxima and minima.

For the year the chief maximum occurred at 9 A. M. with a secondary maximum at 9 P. M. The chief minimum took place at 4 P. M. with its secondary at 3 A. M. The hours of maxima and minima varied during the different months. The chief maximum, which occurred at 10 A. M. during January and Feb-

ruary, was pushed back to 8 A. M. during May, June and July, again occurring at 10 A. M. in December. The secondary maximum showed a less regular movement. Starting between 8 and 9 P. M. in January, it advanced to midnight in July, receded to 9 P. M. in August and October, and advanced to 11 P. M. in December. The chief minimum occurred at 2 P. M. in January, advanced to 5 P. M. in June and July, and then receded to 2 P. M. in December. The secondary minimum changed only from 4 A. M. in January to 3 A. M., where it remained until December, and then advanced to 4 A. M.

(b) Amplitude of the variation.

The mean daily variation between the chief maximum and chief minimum was 0.047 inch for the year, ranging from 0.073 inch in February to 0.040 inch in June. The deviation of the chief maximum from the mean hourly pressure was + 0.026 inch for the year, being + 0.039 inch in February and + 0.015 inch in April, from which time it increased until February again.

The deviation of the chief minimum from the mean hourly pressure was — 0.020 inch for the year. It varied irregularly from 0.042 inch in April to — 0.017 inch in June and August. The mean annual difference between the morning and afternoon maxima was 0.022 inch, and between the two minima 0.010 inch, though the difference between the maxima and minima in the separate months differed considerably from the figures.

A. LAWRENCE ROTCH.

PRESSURE AND TEMPERATURE IN LOW AND HIGH.

The changes in these elements at sea-level are perfectly well known, but, when we consider their fluctuations at some height above the earth's surface, we find opinions very diverse. Theoretically, they should be about the same below and above to a moderate height, but it is thought by some that the higher temperature at the low levels in a LOW will expand the air upward, and we shall finally reach a plane called the "neutral plane," or that of no change, and above that point the pressure gradually rises. Just the height of this plane in each storm it is very dif-

ficult to determine, and, so far as I know, no attempt has been made to fix it even approximately. Observations at the highest stations show the fall in pressure very nearly the same as at sea-level, so that the existence of such a plane may be considered highly imaginary.

Quite recently this subject has received a great deal of attention, and several attempts have been made to reach a practical solution of the problem by means of observations at high stations. M. Dechevrens last year published a paper, in which he tried to show that, while a high temperature accompanied a low pressure at sea-level, the fluctuations were reversed at some height above sea-level, that is, low temperature occurred with a LOW and high temperature with a HIGH. This proposition, while manifestly contradicting generally held opinions, seemed to be sustained by actual observations. At the same time, the present writer had just completed a similar discussion of the actual observations, and had arrived at a result almost directly opposed to that of M. Dechevrens. These results were embodied in four copies of a paper which were sent M. Dechevrens, Dr. Hann, Yale College and Dartmouth College libraries. Still more recently, Dr. Hann has discussed observations on Sonnblick, and has found a confirmation of the results of M. Dechevrens. These results of Dr. Hann have been widely quoted, and it may not be amiss to set forth in this place the methods of discussion that have led to so diverse results, and to attempt an explanation of the seeming anomaly.

M. Dechevrens' method, which was virtually the one followed by Dr. Hann, was to separate out all the temperatures which occurred with high and low pressures, without considering whether they occurred during the passage of HIGH or a LOW. At the outset I think this method hardly satisfactory. It is very well known that a low temperature contracts the air, and *vice versa*, so that the natural tendency would be for a low temperature to produce a low pressure, and *vice versa*. I have often found at mountain stations in the center of high a very low pressure due to this cause. We find a good illustration of this effect in the pressure on a mountain in winter and summer; for

example, in winter the pressure on Mt. Washington is .5 in. (12 mm.) less than in summer.

But this consideration is by no means as important as another which I will give. It is now well known that the minimum pressure on a mountain does not coincide with the passage of a storm center over the station, but lags considerably behind it. The amount of this lagging is not definitely known, but depends upon the height of the mountain and surrounding topography. On Mt. Washington, 6,279 feet, the lagging amounts to about 11 hours; that is, the minimum pressure at the summit occurs 11 hours after the center of the storm has passed over it. A more recent investigation has established the fact that there is very nearly the same lagging in the passage of a high pressure. Prof. Loomis was the first to point out this interesting fact in the case of storms, and it was thought for some time that this indicated an actual inclination of the axis of the storm, but this supposition was soon found entirely erroneous. The present writer, in discussing the records, showed that the lagging was due to the fall in temperature, which always quickly follows a storm. More recently, he has determined that the effect in the case of high pressure is due to the rise in temperature, which immediately follows a high pressure area. It is easy to see that, in the first case, the low temperature contracts the air below the summit, and, while the pressure rises at the base, it continues to fall at the summit till the effect of the low temperature is overcome by the rising pressure.

We have here, then, a very simple explanation of the peculiar results obtained by M. Dechevrens and Dr. Hann. If we wait till the lowest pressure has occurred at the summit of a mountain the temperature has already fallen greatly, and, on the other hand, when the highest pressure has reached the summit the temperature has risen a large amount, so that we seem to obtain a high temperature with a HIGH and low temperature with a LOW. I am well aware that Dr. Hann mentions only low pressures and high pressures in his discussion, but they may well be applied to LOWS and HIGHS, and those who have quoted from him have invariably so applied them. In the following

table I have placed, in parallel vertical columns, for direct comparison, the results obtained in the various discussions:

VARIATIONS OF PRESSURE AND TEMPERATURE WITH HEIGHT.

HIGH.

Dechevrens.				Hann.	
Pic-du-Midi. 2366 metres.		Mt. Washington. 1914 metres.		Sonnblick. 3090 metres.	
mm.	c.	mm.	c.	mm.	c.
552	— 4.8	612	— 2.3	529.3	— 7.7
548	— 2.2	608	— 6.8	525.2	—10.2
544	— 4.3	604	— 8.5	521.2	—12.8
540	— 6.8	600	— 9.6	518.7	—14.7
536	— 8.7	596	—11.2	516.0	—14.8
532	— 9.4	592	—14.7	514.3	—13.9
528	—11.1	588	—15.6	513.2	—16.9
524	—13.5	584	—18.9	511.5	—16.9
520	—14.9	580	—17.8	506.8	—16.0
		576	—21.9		
		572	—23.5		

There is a great uniformity in these results, showing low temperature with low pressure, and *vice versa*. I have studied in a similar manner the fluctuations of temperature and pressure at Mt. Washington, but have obtained nothing like the variation found by M. Dechevrens. It is probable that he has combined only the more marked instances in his table, and, in fact, he says he found a large number of exceptions. From a study of 4,000 observations, I found the temperature on the summit three to four degrees lower at the lowest pressure than at the highest pressure.

When we consider the passage of the storm centre over the summit, however, the result is unmistakable. From a study of all the observations two days before and after the passage of a storm centre, comprising about 4,000 at the summit, I found at the centre of the LOW the temperature —8.0° C., and at the centre of the HIGH —17.6° C. This result is quite extraordinary when compared with that just adduced, and I give here a table showing the means of the observations. The method of discussion was given in this journal for August, 1886. Observations five times each day for five days, including the day of the LOW and HIGH, were studied. The diurnal range in temperature was elim-

inated by subtracting algebraically from each observation the difference between the mean for that hour and the mean for all the hours. I have given the results of observations during forty HIGHS and forty LOWS in groups of ten.

MEAN PRESSURE AND TEMPERATURE AT BURLINGTON AND MT. WASHINGTON.

HIGH.

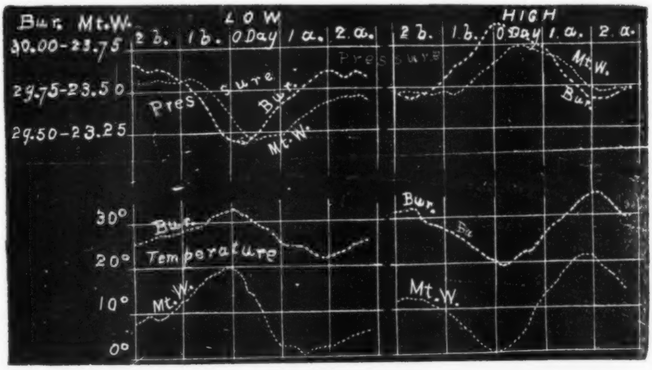
	Two d's bef'r.					One day bef'r.										One day after.					Two d's after				
	7	11	3	7	11	7	11	3	7	11	7	11	3	7	11	7	11	3	7	11	7	11	3	7	11
Burlington.	.78	.75	.76	.79	.80	.82	.83	.84	.94	1.03	1.16	1.18	1.12	1.10	1.05	.94	.85	.74	.70	.64	.58	.57	.58	.65	.70
Pressure	68	67	64	68	67	71	78	81	85	1.05	1.25	1.29	1.22	1.22	1.18	1.06	1.00	88	80	72	66	66	64	65	63
29″+	76	75	71	72	75	84	90	92	98	1 01	1.09	1.07	1.00	1.99	96	91	86	81	81	79	70	68	66	72	71
	74	72	69	71	71	80	85	87	99	1.07	1.21	1.22	1.18	1.16	1.09	99	82	74	71	66	68	75	76	82	83
Mean..........	74	72	70	72	73	79	84	86	94	1.04	1.18	1.19	1.13	1.12	1.07	98	88	79	76	70	66	66	66	71	72
Mt. Wash.	.56	.59	.60	.61	.62	.62	.59	.56	.58	.60	.74	.81	.83	.86	.86	.80	.76	.68	.66	.61	.51	.49	.43	.44	.45
Pressure	37	37	36	38	38	34	34	34	39	45	60	71	75	78	80	75	70	64	63	57	46	45	44	46	47
23″+	52	52	50	49	49	51	54	54	57	59	65	68	68	70	70	71	68	67	69	68	64	58	55	56	55
	44	42	36	33	34	32	35	36	38	42	52	59	61	63	64	56	50	46	44	42	38	38	38	38	42
Mean..........	47	48	46	45	46	45	46	45	48	52	63	70	72	74	75	70	66	61	60	57	50	48	45	46	47
Burlington.	.42	.42	.41	.41	41	.38	.36	.36	.33	.30	.27	.29	.31	.31	.33	.36	.38	.39	.41	43	.42	.41	.39	.38	.37
Tempera-	25	26	30	23	22	23	19	17	14	14	10	11	13	14	15	21	24	25	29	30	33	32	27	32	33
ture.	33	34	34	33	32	32	28	26	26	27	25	25	28	28	28	31	32	35	35	36	38	39	36	36	37
	24	22	21	21	22	21	21	20	19	15	19	13	13	13	15	19	19	21	23	24	25	23	23	23	23
Mean..........	31	31	32	30	29	28	26	25	23	22	20	20	21	22	23	27	28	30	32	33	34	34	31	30	30
Mt. Wash.	.21	.20	.20	.20	.20	.18	16	.15	.13	.11	.8	.10	.12	.14	.18	.22	.23	.25	.27	.29	.27	.25	.23	.20	.17
Tempera-	11	10	10	11	10	8	3	0	-5	-6	-4	-1	1	3	6	12	16	16	18	19	18	16	17	17	17
ture.	11	14	12	13	13	12	10	7	5	5	5	7	9	12	12	17	18	21	23	25	26	24	24	20	17
	9	9	7	6	4	0	-2	-1	-2	-7	-11	-9	-6	-5	1	7	9	12	12	12	11	7	3	4	5
Mean..........	13	13	12	12	12	10	7	5	3	1	0	2	4	6	9	14	16	18	20	21	20	18	17	15	14

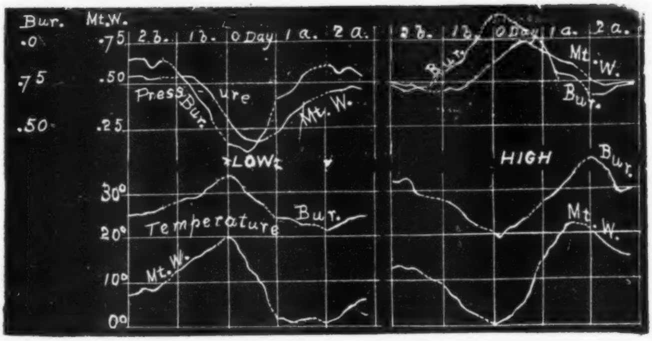
LOW.

Burlington.	.93	.93	.93	.88	.84	.77	.71	.61	.57	.50	.38	.35	.34	.44	.52	.75	.81	.81	.84	.85	.83	.82	.80	.84	.84
Pressure	79	82	81	85	83	77	62	63	56	48	37	43	44	53	58	74	79	78	85	86	88	88	81	79	74
29″+	82	80	74	74	75	74	72	67	66	61	46	42	38	42	40	46	49	52	58	62	72	73	70	72	73
	98	00	00	04	04	06	06	96	89	79	54	51	47	51	52	61	67	71	83	91	99	99	95	97	95
Mean..........	88	89	86	88	86	84	78	72	67	60	44	43	41	48	50	64	69	70	78	81	86	86	82	83	82
Mt. Wash.	.72	.74	.72	73	.72	67	.64	.55	.51	.44	.32	.24	.18	.19	.21	.32	.40	.47	.54	.59	.59	.59	.60	.60	.59
Pressure	44	40	40	44	44	48	47	42	40	32	17	14	11	16	21	28	34	36	39	43	47	49	48	52	48
23″+	59	59	58	56	55	58	57	56	54	53	43	36	32	31	30	22	23	22	24	27	35	38	:9	40	41
	39	44	45	48	50	55	61	60	59	56	42	31	21	13	16	11	17	16	18	21	30	34	34	38	40
Mean..........	54	54	54	55	55	57	57	53	51	46	34	26	20	20	22	23	28	30	34	38	43	45	45	48	47
Burlington.	.36	.37	.37	.38	.38	.40	.40	.40	.40	.41	.40	.37	.34	.32	.31	.27	.28	.29	.29	.29	.30	.31	.32	.32	.32
Tempera-	24	23	24	24	24	27	29	25	28	28	27	24	22	20	19	16	18	20	19	20	20	21	24	24	25
ture.	26	27	27	28	29	31	33	34	33	33	36	36	37	38	39	37	35	32	32	30	29	29	30	30	30
	14	15	16	16	15	15	17	19	20	23	28	26	24	23	23	21	18	16	14	12	9	11	13	14	15
Mean..........	25	26	26	26	26	28	30	30	30	31	33	31	29	28	28	25	25	24	24	23	22	23	25	25	26
Mt. Wash.	.16	.19	.19	.20	.22	.25	.28	.28	.28	.29	.28	.25	20	.15	.10	.2	.2	.3	.6	.9	.13	.14	.15	.14	.14
Tempera-	8	5	6	4	5	9	11	14	15	15	14	11	6	4	2	-2	-1	-1	-1	0	2	5	7	10	10
ture.	14	17	19	18	17	17	17	17	18	19	21	18	18	19	17	13	13	9	8	8	5	5	6	7	8
	-8	-9	-6	-6	-4	-2	3	4	7	11	17	16	8	6	2	-2	-6	-7	-10	-13	-17	-16	-12	-10	-8
Mean..........	8	8	10	9	10	12	15	16	17	18	20	18	13	11	8	3	2	1	1	1	1	2	4	5	6

If the mean of the four sets be projected in curves it will be found that in the case of LOW the lagging of the minimum pressure at the summit appears to be only about four hours. It will be noticed, however, that the diurnal range at Burlington would make most of this difference, for at 11 A. M. the tendency is

toward the daily maximum and at 3 P. M. to a minimum. At Mt. Washington there is a marked tendency to a HIGH pressure for 12 hours after the HIGH has passed the base. Each group of ten shows a well marked tendency toward a lagging of more than eight hours. Only hourly observations with a careful elimination of the diurnal range could give a perfectly satisfactory result.





I have projected each of these groups of ten in curves, and have found that they are almost identical, so that we may conclude that the following laws are quite firmly established:

1st. In both LOWS and HIGHS the pressure lags from 10 to 11 hours at the summit of Mt. Washington.

2nd. The temperature change at the base precedes very slightly the pressure change, but at the summit the change occurs nearly 24 hours *earlier*.

3rd. The temperature appears to be a very little earlier at the summit than at the base, and certainly varies much more rapidly at the former.

4th. In a LOW, the difference in temperature between base and summit is less than the mean before the storm, but the difference rapidly increases after the centre has passed. Just the contrary is true in a HIGH.

5th. The total fall in pressure in a LOW at the summit very nearly equals that at the base, and likewise the rise in a HIGH.

6th. The fluctuation of temperature, that is, from the highest to the lowest, at the summit, is double that at the base in a LOW, but it is only a little greater in a HIGH.

These are some of the more apparent conclusions that can be easily obtained from this discussion, but it seems to me there are other considerations of still greater importance bearing upon our present theory and knowledge of storms and their opposites. It is very satisfactory that this subject of storm conditions at a height above the earth's surface is being so actively studied at present. We have been too well contented with imaginary conditions in the region where it is now admitted all our storms are generated. It seems to me that while at present there appear to be contradictions in these earlier discussions, yet they can be readily explained, and only good can result from a continued and careful study.

H. ALLEN.

September 6, 1887.

ON THE ABSOLUTE REDUCTION OF WIND OBSERVATIONS AT SEA.

In a comparatively recent number of the *Meteorologische Zeitschrift* I noticed a remark deploring the present condition of things in regard to the observation of wind velocities at sea, and it may prove of use to collect a few of the facts and present them to the readers of this journal.

We realize how dependent the navigator of a sailing vessel

must be on the force and direction of the wind, and the great assistance it is to him to know beforehand what course he must take in order to have favorable winds for a voyage between any two ports. This information he can obtain from the various "sailing books" issued by different governments. In order to render these sailing directions accurate, the co-operation of the sailors themselves is necessary, and they are willing to make frequent observations (usually every hour) which they enter in their log-books, to be turned over to the compilers of the sailing directions at the end of their voyage.

In making observations of the force of the wind no instrument is used, and the accuracy of the observation depends entirely on the judgment of the observer.

As long ago as 1805 Admiral Beaufort proposed the scale of estimation now in common use by sailors. He proposed to let *o* represent calm and 12 the strongest wind of hurricane force, the intermediate numbers to represent the various degrees of wind between calm and a hurricane, according to the amount of sail a ship of given type could carry, and the progress it made. The various directions from which the wind comes, the question as to the sailing or steaming of the ship, the different conditions at night and in the day time, all tend to make the estimates very uncertain, both as regards true direction and true velocity of the wind. That these estimates agree as well as they do for different observers shows the skill and accuracy of the ever watchful seaman, and if the conditions of observation remained constant as on land, the results would be nearly as accurate as instrumental observations, so skillful does the observer become in making estimates. Most of the officers on steamships have served an apprenticeship on board of sailing vessels, and carry with them the methods of wind observations learned at first, and it requires some time to enable them to make a correct allowance for the steamship's motion, which may be either with or against the wind, while on the sailing vessel they must always go, in a certain degree, before the wind.

So far as I am aware, however, no observations have been instituted to find out the differences of estimations of wind

force and direction made on the two classes of vessels; in practice the observations of both are combined as being made on the same system.

In estimating the true direction of the wind the observer must make mentally a combination of the apparent direction and velocity and the direction and amount of the motion of the ship; and in making an estimate of the true force of the wind, the same data are necessary.

Rykatschew pointed out, in 1873, the difference between sailing and steam vessels and laments that instruments for determining wind velocities have not been introduced at sea as well as on land. In that year he mounted an anemometer of the Robinson form on board the Russian clipper, "Wsadnik," but never got any report therefrom. His object was to see if the anemometer could be used successfully, and to make a comparison of Beaufort's scale with the miles registered by the anemometer.

The question resolves itself into a simple trigonometrical problem when we have the observed data.

We have the *estimated* true wind direction and force to be compared with the reduced wind direction and force observed on a pennant and anemometer respectively after the actual readings have been corrected for the motion of the ship.

But this is not the method that has usually been adopted. Scott took the observations made on anemometers at several coast stations in England and compared them with simultaneous estimated observations, and by this means got the relation between the Beaufort and anemometer scales. Sprung has done the same for some German coast stations.* For several years anemometers have been mounted on some of the American "Man of War" vessels, but upon inquiry at the Navy Department in 1883 I found that none of the observations could be used for making these comparisons, as the readings were only made at long intervals (of a day, perhaps). With all of the

*The continuous anemometer observations made by the Signal Service at Sandy Hook, Cape May and Cape Henry could be compared with the estimates of wind force entered in the log books of passing vessels. Enough material of this kind to give good results must be in the posession of the Signal Service.

scientific "voyages of discovery" that have been fitted out, I have not seen any that give anemometer observations made at the time of estimates of wind velocities. Perhaps the observations on the "Challenger" will offer a good series of such comparisons, but I have no information concerning it. I know of at least half a dozen American vessels on scientific errands that had anemometers on board, and yet made no observations.

In 1882 I mounted three Signal Service anemometers on shipboard (S. S. "Ohio) and made observations by means of self-registers between Baltimore and the English Channel. The final results of these observations are given in the Monthly Weather Review for January, 1887. The self-registers did not work very well, and a good many breaks in the record occurred, and one anemometer was blown away; but a second experience would prevent these mishaps. Another point affected the observations, but to what extent it is impossible to tell. On board steamships it is the custom to observe only the estimated true direction of the wind, and I was obliged to use this in the reductions in place of the apparent direction as observed on a pennant (of course the reduction formulæ are different), and any error in the estimated true direction would enter into the results. So the point must be carefully noted, in case of future observations, that one can not rely on the log-book for directions of wind, but must institute special direct observations of a pennant to be made at each observation of velocity.

The question of the accuracy of the anemometers enters largely into the values received for the true wind velocity corresponding to the Beaufort scale. This is by no means a settled matter, but all modern authorities agree that the generally adopted Robinson factor 3 is too large, and that the relation of the velocity of the anemometer cups to the true wind velocity is more complex than the simple rule of taking three times the velocity of the cups as indicated by the anemometer dial.

Until further experiments give us more information on the subject we cannot do better than to adopt the formula determined by Dohrandt, at St. Petersburg, by combining the results of anemometers of different dimensions, tested on a

Combe's rotation apparatus at the Central Physical Observatory. He deduces the formula

$$w = K + Ba,$$

where w is the true wind velocity, K the friction constant, and a the velocity of the center of the anemometer cup. The constant B is determined by the empirical formula

$$B = 3.0133 - 53.7367 \frac{R^2}{r} + 1033.81 \frac{R^4}{r^2},$$

where R is the radius of the anemometer cup and r is the distance from the center of rotation to the center of the cup, expressed in meters.

For the anemometers of the German meteorological service the value of B is a very little less than 2.4; for the Signal Service anemometers it would be a very little more than 2.4.

In the accompanying Table I, I have given the comparison of the Beaufort scale with the corresponding velocities registered on anemometers.

Column 1 contains the Beaufort scale. Column 2 gives the values obtained by Köppen by a new combination of the data used by Scott in obtaining his values, but Köppen has assumed a friction constant (K) of 0.3 meter per second, instead of 1.0 meter per second, which is adopted value of K for the others, because he considers that, as the English anemometer gives higher results than the German ones for a low velocity, the constant should be assumed at its minimum value. In column 3 we find the values obtained by Sprung. Column 4 shows the values computed by Köppen from the formula $w = 1.66 + 1.12 n + 0.045 n^2$, where w is the wind velocity (in meters per second), n the corresponding number of Beaufort's scale, and the constants being determined from the combination of Scott's and Sprung's values given in columns 2 and 3. (Columns 1, 2, 3, 4 are taken from Köppen's paper in the *Ostern. Zeit. f. Meteor.*, 1879). Column 5 contains the values received by Waldo from the mean of three anemometers at different exposures* (27, 33

*The anemometers mounted by me on ship board were placed as follows: one on the wheel-house at the stern, another on the bridge amidship, and another on the mainmast. I came to the conclusion that the one on the wheel-house had the best exposure, all things being considered.

and 80 feet above the water) on ship board; *the total number* of miles of wind is used that was recorded for the hour when the estimate according to Beaufort's scale was made. (It was found that this did not differ materially from the result obtained by taking the velocity for a few minutes at the time of estimating the wind velocity and multiplying this by the quantity that would give the miles per hour). Column 6 gives Waldo's results for a single anemometer mounted on the wheel-house at the stern of the ship (this being considered by me to be the best location for a single instrument. —F. W.), the reduction being for the whole hour, as in column 5. Column 7 shows the values given by Scott and usually quoted (see Mohn's Meteorologie) *but* reduced by the formula adopted here and using a frictional constant 1.0 (meters per second) instead of the value adopted by Köppen; (in the values given by Scott in 1874 and Mohn in 1883 the anemometer velocity is multiplied by 3 to give the wind velocity).

TABLE I.—METERS PER SECOND.

Beaufort's Scale, 1-12.	Scott's Data, reduced by Köppen.	Sprung's Results, given by Köppen.	Köppen's Formula from Col 2, 3.	Waldo's Results. Mean of three Anemometers.	Waldo's Results, using Anemometer on Wheel-house only.	Scott's Results. Reduced by same formula as Sprung's and Waldo's.
0	2.1	1.9	1.66			
1	2.9	2.7	2.82	3.5	3.5	3.9
2	4.2	4.0	4.08	5.3	4.6	5.6
3	5.3	5.4	5.43	6.4	5.6	7.4
4	6.9	6.8	6.86	7.4	7.1	9.2
5	8.7	8.2	8.39	8.9	9.2	11.0
6	10.7	9.8	10.00	11.7	12.4	13.0
7	12.7	10.7	11.70	13.5	15.3	15.5
8	14.5	12.4	13.50	16.0	16.4	18.3
9	15.7	14.9	15.38	18.9	17.8	21.2
10						
11						
12						

Table II is a repetition of Table I, but the values are given in miles per hour.

The difference between the values given in columns 2 and 7 is very considerable, and it is surprising that two meteorologists should disagree so widely in results deduced from the different combinations of the same data. (In comparing these two columns, however, the values in No. 7 must be decreased by 0.7 in order to allow for difference of adopted friction constant).

TABLE II.—MILES PER HOUR.

Beaufort's Scale. 1-12.	Scott's Data, reduced by Köppen.	Sprung's Results, given by Köppen.	Results by Köppen's Formula, from Col. 2. 3.	Waldo's Results, Mean of three Anemometers.	Waldo's Results, using Anemometer on Wheelhouse only.	Scott's Results. Reduced by same Formula as Sprung's and Waldo's.
0	4.70	4.25	3.71			
1	6.49	6.04	6.30	7.83	7.83	8.72
2	9.40	8.95	9.13	11.86	10.29	12.53
3	11.86	12.08	12.15	14.32	12.53	16.55
4	15.44	15.21	15.34	16.55	15.88	20.58
5	19.46	18.34	18.77	19.91	20.58	24.61
6	23.94	21.92	22.37	26.17	27.74	29.08
7	28.41	23.94	26.17	30.20	34.23	34.67
8	32.44	27.74	30.20	35.79	36.69	40.94
9	35.12	33.33	34.41	42.28	39.82	47.42

In Vol. VII, No. 2, of the *Repertorium für Meteorologie*, published by the Central Physical Observatory of Russia, Rykatschew has given tables for the reduction of anemometer observations on ship board, but he does not give any reductions of actual observations. I find that a graphical solution of the problem is the simplest for one who has not access to the tables of Rykatschew. This can be so arranged that the reduction of the single readings takes no more time than the use of computed tables, and the preparation of reduction charts does not require as much time as the computation of tables, and is sufficiently accurate.

FRANK WALDO.

CINCINNATI, O., Sept, 1887.

THE RELATION OF THE POLE OF THE LAND-HEMISPHERE[1] TO CONTINENTS, TO THE MAGNETIC SYSTEM, AND TO SEISMIC FORCE.

[ABSTRACT.]

I. *Relation to the Land System.*—In a former paper[2] allusion was made to the equal quaternate segmentation of the earth; but the more intimate relation of *R* to the four segments was not then pointed out. The two meridional G. C's, which define these four segments, are found respectively 45° E. and W. of R, each segment containing a double continent, if we include sunken Oceanica. One of these G. C's marks the N. and S. depression of the Caspian Sea and the eastern Pacific Ocean, from Vancouver's Island S.; also the N. and S. elevation, in Europe, of the Urals, and in North America, of the Cascade and Coast ranges, probably giving origin (between these and the Rocky Mountains) to Death Valley, 100 feet below the sea level, and to the Sandy Desert, 300 feet below the ocean.[3] The other G. C. runs N. and S. through the deepest portions of the Atlantic, near the Azores and Brazil, then through the Pacific near Japan.

Thus *R* is the centre of the central double continent, and is 90° respectively from the elongated meridional centres of Asia and of North America. *R* is also approximately half-way from the equator to the N. pole of rotation, and is equidistant from the S. W. cape of Australia (Cape Leenwin) and from Cape Horn.

While this arrangement, in conjunction with the five eastern Continental trends (A, B, C, D, E,) and their mates (A′, B′, etc.),[4] seems as if designed to limit the Continents E. and W., it by no means precludes great relative changes of land and water, within these bounds, especially from the Archæan foci[5] in the N., to the relatively large Cenozoic areas farther S.

1. R (Rosa) is the abbreviation used for the Pole of the Land Hemispheres.
2. Boston Proc. A. A. A. S., p. 438.
3. Guyot's Phys. Geogr., p. 31
4. Montr. Proc A. A. A. S., p. 330.
5. Boston Proc. A. A. A. S., p. 441.

Attention was also formerly called[1] to the topographical and geological peculiarities connected with concentric circles having respectively a radius from *R* of 9°, 12°, and 36°, to which may be added the evident tendency also to concentric elevations from that focus. Thus it is the same distance from *R*, 1st, to the ancient volcanic regions of Auvergne, the Eifel and Central Italy; 2d, to Santorin, the mud volcanoes of Perekop, and the ancient volcanic region of the Hebrides; 3d, equidistant also to Heckla, the Azores, Madeira and Canary Islands, Elburuz in the Caucasus and the extinct Armenian volcanoes; 4th, to Fogo and the volcanoes in the Red Sea and Abyssinia; 5th, to the basalts of Lake Superior (centre of North America), and the hot springs and bitumen of Lake Baikal[2] (centre of Asia); lastly, to Sangay, etc., on the west, and Krakatoa, etc., on the east.

II. *Relation of R to the Magnetic System.*—*R* is approximately on the same meridian as St. Thomas's Island (in the Gulf of Guinea) which is the centre of Africa, as well as the mean intersection of the magnetic equator of dip with the terrestrial equator; the equator of intensity being somewhat farther S.; and the equidistance from this area to the foci of magnetic intensity has been already pointed out.[3] N. and S. of these lines, as is well known, the action of the inclination needle, and the horary diurnal variation of the horizontal needle, are reversed. From this region also it is the same distance to the western agonic at the equator (as it passed 25–30 years since subcentrally through North and South America) that it is to the eastern agonic (as it passed subcentrally S. to N. through Australia and Europe-Asia); it does not vary much from that now.

If the secular declination of the horizontal needle[4] is due to the periodical, cosmically dependent, climatic modifications in the eastern and western hemispheres, (the isochimals and

1. Boston Proc, A. A. A. S., p. 445.
2. Erman considers Lake Baikal probably a volcanic fissure.
3. Montreal Pro. A. A. A. S., p. 335.
4. For a more full discussion of this subject, see AMERICAN METEOROLOGICAL JOURNAL for Oct., and Dec., 1886, and Jan., 1887.

geothermal lines going N. in Siberia for about $3\frac{1}{3}$ centuries, while they move S. in America for the same period; and afterwards for $3\frac{1}{3}$ centuries the reverse), then, in accordance with Oersted's law, the horizontal needle of middle Europe must move W., as it actually did during the above descibed former period (from pointing $11\frac{1}{2}°$ E. at Paris in 1580) until 1663, at which time it was zero, and then continued W. until 1814, when it reached greatest westing at Boothia Felix, as the N. W. magnetic pole. It then commenced its eastern march, probably to be again agonic, in middle Europe, A. D. 1996 (viz., 1663+333) or thereby, and attain greatest easting[1] (at some point in North Siberia as the N. E. magnetic pole) about A. D. 2147 (viz., 1814+333).

III. *Relation to the Seismic System.*—An accurate analysis of the 7000 earthquakes catalogued by Mallet from earliest record to 1842, as well as of about 2500 more tabulated by Prof. Alexis Perrey, from 1843 to 1869, shows that over 90 per cent. can be traced to one or other of the six G. C's which traverse *R* at 30° apart (especially if we extend them to the equator of the land and water hemispheres), and which caused the alternate depressions and elevations, converging to *R*; such as of the former, the Bay of Biscay, Gulf of Genoa, Adriatic, Black Sea, Baltic, North Sea; and, among the latter, the mountains of Corsica and Sardinia, the Apennines, Balkans, Alps, Carpathians, Vosges, etc. If, however, we confine our observations to the area around *R* which would be enclosed by the above radius of 12°(=720 geogr. miles) we would have about 2,000,000 square miles, or approximately the one-hundredth part of the earth's superficies; and three-fourths of the above earthquakes would be found within that limit. This area encloses many places that are sometimes daily shaken for months, such as: Nice, Barga, Briquerasque, Pignerol, Brieg, Ouches in Chamouni, Janina, Cattaro, Agram, Moor and Comorn.

As proof that seismic disturbance is often transmitted from this central area to more remote vents, or *vice versa*, may be cited the coincidence, almost synchronism, between Icelandic

1. Montr. Proc. A. A. A. S., p. 336.

eruptions and seismic phenomena in southern Europe. Taking the dates of the eruptions from Boehmer's Catalogue[1] and then referring to Mallet's list of earthquakes for that date, it will be found that nearly every eruption in Iceland was attended by extensive earthquakes in Switzerland, Italy or Sicily, sometimes also in England, all connecting through *R* with Iceland, along G. C. "B′."

An additional test (regarding the predominance of seismic phenomena under the dome of the land-centre) can be readily made by any one having access to Mallet's Catalogue, thus: Let the book be opened *anywhere* indicating earthquakes of the last four or five centuries; then, counting the entire list on the double page thus opened, and afterwards counting those on the same double page that would come within the 12° radius of *R*, it will almost invariably be found, however often the trial is repeated at some new page, that more than one-half are within the area; the ratio[2] is frequently as high as two-thirds, and occasionally even three-fourths.

It is interesting further to remark that the pulsations under the Swiss dome, even when *R* is not the epicentrum, seem to find vent at the equator of the continental and oceanic hemispheres, which marks a belt of seismic power, extending from Japan to Sumatra, and along some of the Andean volcanoes to those of Mexico, the Peninsula of California, Aleutian Islands, etc. That Japan should be scourged with earthquakes, is to be expected, as Prof. Milne[3] has found in that empire 53 volcanoes, active within the historical period; and these Islands have also their *Pacific* slope, on which *all* the Japanese earthquakes occur,[4] close to G. C. "A"; they are likewise at the junction of R^6 with the equator of *R*.

There was also, chiefly in Tertiary times seismic activity

---

1. "Volcanic eruptions and earthquakes in Iceland, from a history by Th. Thorodd son, compiled by Geo. H. Boehmer," Smithson. Rep't for 1885.

2. This ratio might be somewhat modified, if Mallet's Catalogue contained as full returns from Japan and America, as from Europe; but would still probably leave a plurality.

3. Earthquakes, by John Milne, Intern. Series p. 227.

4. See Report on Japanese Earthquakes for 1885, by Prof. Seikei Sekiya, of the Tokio Imperial University.

under the centre of each continent,[1] judging from the basalts and other volcanic evidences, at or near each continental centrum, as fully set forth in the unabbreviated paper.

Seismic phenomena not traceable to the hemispheric or to the continental domes, can usually be found connected with one or the other of the five equidistant eastern continental coast trends, or their western mates.[2]

Most modern writers consider all seismic phenomena as due to one and the same *remote* cause. Judd says: "The close connection between most earthquakes and volcanic phenomena is a fact that does not admit of the smallest doubt." Several scientists[3] agree, that where there is much sedimentation, there must be horizontal crushing, conversion of mechanical energy into heat, then vertical elevation and downward fissuring, hence fissure eruptions; sedimentation, therefore, is essential to mountain making. Prof. Milne (at p. 230 of work quoted above), seems to favor the same idea; and cites Rossi as of opinion that "volcanic fractures play an important part in governing the distribution of seismic disturbances." * * * "Earthquakes are propagated along the direction of these fissures."

A few examples may be given to illustrate the assignment of earthquakes to one of the six groups connected with land-centres: an earthquake at Basle, Strasburg or Tunis is on R^1; at Etna, Calabria or Iceland on R^2; at Santorin or Janina on R^3; seismic phenomena in Armenia or near the Caucasus, Cutch, or Sumatra, on the E., in Auvergne, at the Azores, Antilles, Caracas or Quito, on the W., are on R^4; those of the Grisons, Engadine, etc., on R^5; and of Marseilles, Toulon, Augsburg and St. Petersburg on R^6.

Probable Influence of the Earth's Motion on Refrigeration. —The secular refrigeration, shrinkage, fissuring, mountain-making, and some faulting, seem usually coincident either with

1. Boston Proc. A. A. A. S., p. 441.
2. Montr. Proc. A. A. A. S , p. 330.
3. Elements of Geol., by Prof. Le Conte, p. 258; Origin of Mount-Making, by Prof. T. Mellard Reade, p. 10; and "Traité de Géologie," by De Lapparant, p. 1225; besides works of Prof. Dana, Dawson, Gilbert, Capt. Dutton and others, giving views slightly modified.

the earth's axis of rotation or revolution; and the tendency has been already pointed out for earth tremors to be propagated from earthquake centres along G. C's which accord with mountain ranges[1] or sometimes with faulting. The paper calls special attention to the apparent influence exerted on land-form by the earth's rotation on its axis; and equally, if not more prominently, by her orbital revolution, producing, probably, secular refrigeration, in planes parallel to the axis of the ecliptic. To the former class belong the great continental central depressions, such as Hudson's Bay, Gulf of Mexico, Caspian Sea, as well as some elevations (e. g.: the Urals, Cascade range, part of Andes, etc.,) and vertical coast lines, alternating with diagonals; to the latter seem due the *general* coast trends,[2] as well as many mountain ranges (such as the Appalachians, Apennines, Altai, etc.,) which cross the meridians at an angle of about 23°–24°, running consequently from the Arctic to the Antarctic Circle.

Possibly, the changes in the coast lines and in the Cordilleras, Rocky Mountains, Yablonoi and Stanovoi Mountains, etc., from vertical to diagonal, may be connected with nutation, precession practically ceasing at the time of the equinoxes; but having full force at the summer and winter solistices.[3]

R. Owen.

New Harmony, Ind.

THE CLIMATE OF PEORIA.

[CONCLUDED.]

Read before the Peoria Scientific Association, September 24, 1886, by Fred Brendel, M. D., ex-President. From the *Bulletin* of the Scientific Association.

The mean temperatures for the decades are the following for September: 1st = 70.8, 2d = 66.4, 3d = 63; for October, 1st = 59.7, 2d = 53.5, 3d = 48.5; for November, 1st = 45.5, 2d = 38.8, 3d = 33.9. The coldest decade in September was the 3d in 1856 = 52.7; the warmest the 1st in 1884 = 81.3; the coolest in October the 3d in 1869 = 36.3; the warmest the

1. Boston Proc. A. A. A. S., pp. 438 and 439.
2. As shown in Key to Geology, p. 36.
3. Airy's Popular Astronomy, p. 186.

1st in 1879 = 76.3; the coolest in November the 3d in 1880 = 20.3; the warmest the 1st in 1874 = 54.5. The highest stand of the thermometer was observed on the 3d of September, 1864, and the 5th of September, 1881 = 98, on the 3d of October, 1856, 12th of October, 1879, and 8th of October, 1884 = 90; on the 7th of November, 1874 = 77; the lowest on the 29th of September, 1871 = 34; on the 24th of October, 1869 = 14; and 23d of November, 1857 = —1.5.

By comparison of the temperature of different places in Illinois during the meteorological year December, 1869, to November, 1870, we find in the mean temperatures of Peoria, Springfield, which is nearly a degree farther south, and Ottawa, which is more than half a degree farther north, scarcely any difference, but Galesburg, farther west and on a higher elevation, had that same year a mean of one degree lower and a January very much colder. Of the same year the temperatures of Steubenville, O., Fort Madison, on the Mississippi, and Nebraska City, on the Missouri, all nearly in the same latitude with Peoria, compared show the following figures:

	Mean of the year.	In winter.	In summer.
Steubenville....	54.5	34.3	75.2
Peoria..........	54.	29.6	76.6
Fort Madison..	52.3	27.8	76.6
Nebraska City..	52.	27.5	74.8

The means of the year are decreasing from east to west in the same way; lower the temperatures of the winter, but the summer is the hottest on the Mississippi and on the Illinois, well considered that Steubenville and Nebraska City are on a greater elevation above the sea-level and that the climate of Steubenville is influenced by the Canadian lakes.

By a mean period of frost of 183 days for the season free of frost, 182 days would be left, and so the year would equally be divided; but as the last frost day in 30 years occurred on the 11th of May and the first on the 1st of October, there would be left only 142 days, and even that is good only for the locality of the observations in the midst of the city: for on exposed places

in the open country even in this period frosts may occur, and indeed on the 4th of June, 1859, when the thermometer in the city showed a minimum of 35, and on the 29th of August, 1863, when the mercury went down to 41, frosts were reported from the surrounding country. Moreover, the so-called "white frost" may be formed at a temperature of the air above freezing point. All bodies radlate heat and their temperature lowers, when they do not receive a fresh supply of heat from outside. So do the plants at night time. Radiation takes place in all directions to the surrounding air. A small thermometer placed in the grass on an unprotected place may very likely show 10 or more degrees less than one that is suspended five feet above the ground. The plants exhale constantly water in gas form, which precipitates upon the cooled surface, and when that cooling reaches the freezing point white frost is formed.

The difference of temperatures observed in localities of the same latitude shows that meteorological observations of one locality are good only for that locality and perhaps its next vicinity, and it is lost labor to compute averages for wider districts; for instance, of the State of Illinois, divided by straight lines in a northern, central and southern part, or for even larger areas of five or six states, comparing the results with the crops of the same districts so different not only of temperature and precipitation but in the nature of the soil. There is no more sense in it than would be in computing the temperature of the whole of North America. It is only waste of time and paper.

The means of the single years range between 8 degrees. The lowest mean temperature of a year was that of 1857 = 48.7; the highest that of 1878 = 56.7. The mean of the first 10 years was 52.1; of the second, 51.4; of the last, 52.7.

BAROMETER.

The observations on the pressure of the atmosphere comprise 25 years, from December, 1860 to November, 1885.

The mean reduced to freezing point was 29.628 inches; the mean at 7 A. M. is 29.644; at 2 P. M. 29.606; at 9 P. M. 29.634. The highest stand was observed in January, 1886 = 30.671, and

the minimum in April, 1880 = 28.581, the range being 2.090. The greatest range in one month was observed in January, 1866 = 1.676; the smallest in August, 1878 = 0.283. The highest mean of a month had December, 29.698; the lowest May, 29.548. The greatest range in 24 hours was observed in January = 1.028; in July it is only 0.389.

There are generally two oscillations in 24 hours, with two minima at 11 A. M. and 10 P. M., and two maxima at 4 A. M. and 4 P. M. The rise and falling is in the tropic countries so regular that it is possible to determine the day-time from the stand of the barometer; in our zone it is more variable, so that often a continuous falling or rising for several days is observed.

PRECIPITATION.

The mean quantity of rain and melted snow was 35.6 inches per year in 100 rainy days. The smallest quantity falls in January, 1.6 in 7 days, the greatest in June and July each with 4 inches in 10 and 9 days. The precipitation in winter is 6.1, in spring 9.7, in summer 11.2, in fall 8.6. This would be favorable when distributed in that way every year; but the single years differ very much. In 1856 it was only 22.8, in 1856, 51.4. There are sometimes long droughts. From the 29th of August to the 8th of October, 1871, there was only one rainy day in the middle of September with 0.65 of an inch of rain. The longest period without any rain was in 1861, in October and November, which lasted 28 days. There was one of 21 days in April and May, 1863, of 20 days in July, 1873, of 19 days and the same in July and August, 1869. Sometimes there are long periods of too much rain, for instance in 1858 from the 29th of April to the 10th of June 15.7 inches in 27 rainy days.

The quantity of rain is of less importance than the number of rainy days and their distribution. The highest number for one month was 18 in May, 1858, and in July, 1865; the lowest in September, 1871, and February, 1877, each with one rainy day. Suppose that 11 inches of rain in 26 days of the three summer months be the most beneficial, and that a plus or minus of 2 inches and 2 rainy days be of no importance, then we had in the

summers of 1862, 1869 and 1872 a great excess in quantity, viz.: 9.1, 7.8 and 10.8 inches surplus, and an excess in the number of rainy days in 1865 and 1866, viz.: 13 and 7 surplus. A deficiency in quantity shows the years 1870, 1868 and 1865 with 6.6, 5.8 and 5.6 minus, and in rainy days, 1863 and 1856, viz.: 12 and 8 minus. The most normal summers (in regard to rain) were 1857 and 1871. The greatest quantity of rain for one month was measured in May, 1858, = 10.64; then in June, 1872, = 9.73, and in September, 1875, = 9.6.

The mean precipitation of the single months are: December, 2.5; January, 1.6; February, 2; March, 2.7; April, 3.2; May, 3.8; June, 4; July, 4; August, 3.2; September, 3.5; October, 2.7; November, 2.4.

HUMIDITY OF THE ATMOSPHERE.

The relative humidity of the air was computed from the difference of the wet and dry thermometer by means of Guyot's tables. When there is no difference, the atmosphere is saturated with moisture, and that is noted by 100; the greater the difference the lower is the percentage: 20 means very dry, and there is scarcely ever noted a lower figure. The means of the year are at 7 A. M. = 81; at 2 P. M. = 58; at 9 P. M. = 75. The highest mean in January at 7 A. M. is 89; the lowest in May, 2 P. M. 50.

The pressure of vapor is the highest in July, 9 P. M. = 0.669 of an inch; the lowest in January, 7 A. M. = 0.114. The means for the year are 0.316 at 7 A. M., 0.338 at 2 P. M. and 0.340 at 9 P. M.

CLOUDINESS.

The cloudiness of the sky is expressed by figures, which mean the percentage of covering; 100 was noted when the sky was entirely covered, 50 when half, and so on, and 0 when cloudless. The sky is most covered in December in the morning, and least in August in the evening. The mean for the year is 46; the highest for a month has December = 55; the lowest August = 35.

SUNSHINE.

From the amount of cloudiness cannot be deduced the time of sunshine during a period; for the sky may be half covered, yet

the sun may shine during the whole day. It is necessary to note the time of sunshine every day. This was done from December, 1859, to November, 1868, and the result was that we had sunshine 58 per cent. of the time from sunrise to sunset. The sunniest months are June and August, each with 71 per cent.

How great the influence of insolation must be upon the growth of plants is shown by the difference of the thermometer in the shade and exposed in the sun, which in June exceeds 20 degrees, and more yet in winter.

WIND.

West winds are prevalent from October to April; south winds during the summer; only in August east equals the south. About 12 for each 1000 of observations are marked as high winds, gales or hurricanes; but the force of winds was not measured by the anemometer, but only estimated, and the dates are not quite reliable. The windiest months are March and April, the calmest August and September.

Wind and temperature, wind and cloudiness, wind and precipitation are in a certain degree correlative. The warmest winds are south, southwest and east; the coldest northwest, north and northeast; the difference between the coldest and warmest winds is about 15, in spring even 20 degrees. Above the average is the temperature with south and southwest in all the months with east only in the spring and fall. Southeast wind is too scarce, so that no reliable mean could be abstracted. The temperature of north is always below. Northeast is only in November, December and January above, and that may be accounted for by the great quantity of cloudiness that always accompanies these winds, preventing radiation. Northwest has only in August a temperature above average. The region from which this wind comes, is naturally a cold one, only during the summer months excessive heat is accumulating, which has the above effect upon these winds. The same reason is good for the west during all the summer months; in the rest the west winds are cooler.

Northeast brings the most cloudiness and west the least; the west is the only one that has a cloudiness considerably below the average.

The relation of wind and precipitation must be considered in a double way. When we compute the direction of wind in 1000 observations of precipitation, then we find that we have 258 times south wind, 174 times east, 159 times northeast, 105 times southwest, 95 times west, 84 northwest, 79 north, and 46 times southeast. But when we reduce the observations of precipitation to 1000 of each wind direction, then we find for each wind the following per mille of rain observations: Northeast, 317; southeast, 153; southwest, 132; south, 126; northwest, 124; east, 111; north, 93; west, 46. That shows that northeast is the prevalent rain wind. But the single months differ. In summer southwest brings the most rain, and nearly all the thunderstorms come southwest, west or northwest. The average number in a year is 28.

REDUCTION OF THE BAROMETER TO SEA-LEVEL.

[CONTINUED.]

The *method of reduction* comprises two parts, which are quite distinct from each other; the *formula of reduction*, and the *process of reduction*.

In the choice of the *formula* we have only to keep to the limit of 0.1 mm. or 0.01 mm., and reject all formulæ which do not satisfy these requirements. In the first place, it is obvious that an accurate formula intended to yield results useable under all circumstances, in all latitudes, at all heights above sea, at every reading of the barometer, at every temperature and every degree of humidity, must contain all those variables. It is moreover plain that empirical formulæ framed for certain conditions cannot be correct for all the conditions to be met with over the whole globe. Furthermore, not one of the empirical formulæ takes all the five variables into consideration, and if it can be proved that all of these variables have an influence on the result of the calculation, it follows that all the empirical formulæ must be rejected. The influence of altitude, of the barometer reading, and of temperature are undeniable, and we have therefore only to consider the two factors which have the least importance, the geographical latitude and the humidity.

At the height of 2,000 metres above the sea, and with a difference of 80° in latitude, the latitude gives rise to a difference in the reduction amounting to 0.88 mm.

The humidity at the same altitude, at a temperature of 20° C. and a relative humidity of 87 per cent., gives rise to a difference of 1.63 mm. We see, therefore, that neither element can be disregarded.

The only formula which meets all requirements is that of Laplace, as corrected by Bauernfeind and Rühlmann. What has still to be done is to calculate for this formula all the constants, according to the latest results of the science; and in addition to such a critical examination of the formula, this must be brought into such a form as will admit of the construction of non-logarithmic tables with double entry.

I myself have solved this problem, but have been prevented by other work from publishing my results.

When the formula is theoretically exact, we have to apply it correctly. This is termed the *process of reduction*, and it presents the greatest difficulties, as our knowledge of the natural laws involved in it is insufficient. The tables must be calculated by a correct formula of reduction, but the process of reduction, that is, the use of these correct tables, may be modified according to circumstances, without detracting from the value of the tables. The latter must, for instance, be calculated on the hypothesis that the methods of reduction yield mean temperatures of the assumed air column which are correct, and if subsequently other methods of calculating more correct mean temperature are discovered, the tables will not be affected thereby.

The most difficult part of the work of reduction is the determination of the temperature of the imaginary air columns, but this is not nearly so difficult as is generally supposed, for Bauernfeind, Rühlmann, and Belli have assumed that temperature is responsible for all defects in the formula and in the process of reduction, and even for all known omissions. Belli, Bauernfeind, and Rühlmann found the altitudes calculated from barometric readings did not agree with those determined by leveling, and they then inverted the formula, calculated a tempera-

ture which would give the correct altitude, and call this the "theoretical" temperature (Belli), or the "true" temperature (Rühlmann).

This theoretical or true air temperature did not agree with the observed temperature, and so Rühlmann concluded that the thermometers gave no information as to the real temperature of the air between the points.

It is therefore desirable to examine Rühlmann's investigation critically, for such an examination shows that it is not above suspicion.

The thermometer exposure during the Valtenberg observations appears to have been not quite perfect as against radiation. The reasoning is mainly based on the observations at Geneva and the Great St. Bernard; but these stations are so situated that no comparison of their results can be held to be quite satisfactory. The situation of the station at St. Bernard is so unsatisfactory that no wind observations can be published. The other station (Geneva) is situated on a large lake, and between the two stations there lie high mountains with glacial temperatures. For the night hours interpolations are made, and no hygrometrical observations at all are made at the St. Bernard.

Plantamour has supposed the existence of local depressions in the temperature observations, at one and even at both of these stations, and no one has considered that these stations are situated under different isobars and isotherms. Not only are the observations themselves unsuitable for such fundamental inquiries, but even the investigations themselves have not been carried out accurately, for Rühlmann has calculated not with his own accurate formula, but with Bauernfeind's; and finally in the calculation of the true temperature he has so greatly simplified the formula, that it cannot possibly yield correct results. In spite of all these omissions and defects of observations, the differences between the true and observed temperatures are smaller than those which may be introduced by errors in the barometrical observations.

[TO BE CONTINUED.]